UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

# HYDRAULIC MODEL STUDIES ON THE PROPOSED WATER MEASURING DEVICE AT DRY CREEK TURNOUT LATERAL 24.2--MADERA CANAL CENTRAL VALLEY PROJECT, CALIFORNIA

Hydraulic Laboratory Report No. Hyd-378

ENGINEERING LABORATORIES BRANCH

DESIGN AND CONSTRUCTION DIVISION
DENVER, COLORADO

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Laboratory Report No. Hyd-378
Hydraulic Laboratory Section
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Subject: Hydraulic model studies on the proposed water measuring device at Dry Creek Turnout, Lateral 24.2--Madera Canal--Central Valley Project

## SUMMARY

Investigations were made on two proposed designs. On the basis of the studies, the preliminary design, Figure 3A, was recommended for installation. However, either design would perform adequately under the operating conditions at which they were tested.

## INTRODUCTION

In connection with a proposal to install a water-measuring device on Lateral 24.2 of the Madera Canal, the Hydraulic Laboratory performed a model investigation to evaluate the proposed design. The proposed installation included a transition section and a standard 10-foot Parshall flume to be installed at Station 0+53.0 of Dry Creek Turnout, Figures 1 and 3A.

The model investigation was made to determine whether the transition section would provide uniform flow distribution and a smooth water surface in the Parshall flume.

The model, shown in Figure 2, was constructed to a scale ratio of 1:10 and included the turnout entrance at the canal, the parallel, gate-controlled rectangular conduits, the transition section, and the Parshall flume. Since this was not a submerged Parshall flume, only a short section of the channel downstream from the flume was included in the model.

## THE INVESTIGATION

The adequacy of the design was determined by the appearance and distribution of the flow in the transition approach to the measuring flume and by the magnitude and frequency of the surface waves in the flume. The former was determined by photographs and by visual observation of dye streams injected into the flow. The magnitude and frequency of the waves were determined by an electronic wave recorder placed at the location of the staff gage, Figure 3.

Preliminary tests showed that the severest operating conditions occurred with the maximum water surface elevation in Madera Canal and maximum discharge, 230 cubic feet per second, into Dry Creek Turnout. A more severe condition occurs with greatly unbalanced flow through the conduits, but since other model investigations* had shown that the resulting poor flow distribution was impossible to correct without an elaborate and expensive structure, it was decided that operating instructions should specify uniform operation of the gates.

Figure 4 shows the appearance of the flow in the preliminary design. The flow was very smooth and well distributed in the approach transition; a few eddies were noticeable, but it was thought that their magnitude and severity was such that they should not have much effect on a current meter measurement. Dye injected upstream from the transition showed that the flow was uniformly distributed across the section by the time it entered the measuring flume. The wave action in the flume was practically negligible; electronic measurements showed that the average water surface fluctuation in the prototype would be approximately 1/2 inch and would occur about twice a second while the maximum fluctuation, approximately 1-1/4 inches, would occur about once in 10 seconds. Figure 5 shows the water surface fluctuations as measured. The curves are direct tracings from the oscilloscope records with the ordinates and abscissas converted to prototype dimensions.

The one disturbing feature in the flow appearance was the presence of a small ripple on the water surface in the flume. The ripple was about 0.10 foot high and was caused by the abrupt change in direction of the side walls at the upstream end of the Parshall flume, Figure 3A. It was felt that since the ripple was near the side wall, it might be reflected in an erroneous reading at the water surface elevation gage. Although the flume will probably be rated to provide a true depth-discharge relation, the designers felt that an attempt should be made to eliminate the ripple.

The design was modified by making the transition side walls parallel for 8 feet upstream from the flume, Figure 3B. This increased the angle of divergence of each side wall from 5° 10' to 6° 36'. The other dimensions of the transition and flume were not altered.

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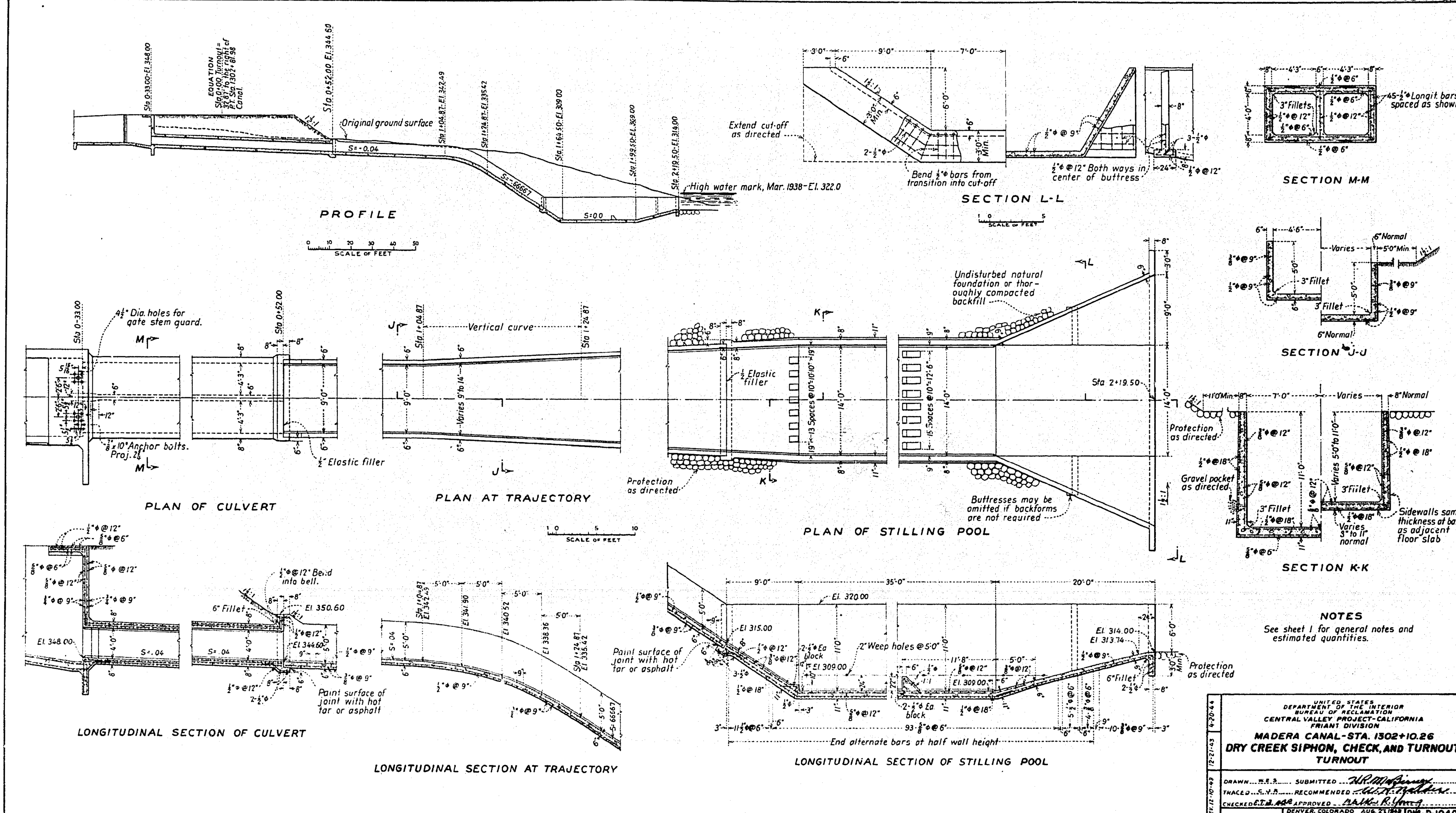
*Hydraulic Laboratory Report No. Hyd-322, "Hydraulic Model Studies of Turnout Structure--East Low Canal--Columbia Basin Project, Washington"

Figure 6 shows the flow appearance in the modified structure. The slight increase in the wall divergence was sufficient to cause the flow to become unstable and to increase the magnitude of the surface fluctuations. The average fluctuation was approximately 1 inch, with a frequency of about once every 2 to 3 seconds, Figure 5B. Dye streams in the water showed that the approach flow in the transition was not as uniform as had been found in the preliminary design.

The modified transition lessened the small ripple, but since the approach flow and water surface fluctuation were not as satisfactory as had been found in the preliminary design, the preliminary design was recommended for installation.

Another test was performed to determine the permissible difference in opening of the two gates before unsatisfactory flow conditions occurred in the transition and measuring flume. At normal canal water surface, the Dry Creek Turnout gates can be operated with a difference in opening up to approximately 1 foot before the flow in the flume will become unstable. Thus, any reasonable attempt to adjust the gates for uniform opening should result in satisfactory performance.

FIGURE 1


PROFILE
Original ground surface
High water mark, Mar. 1938-El. 322.0
SCALE OF FEET
SECTION L-L
Extend cut-off as directed
Bend ½"φ bars from transition into cut-off
½"φ @ 12" Both ways in center of buttress
SECTION M-M
3" Fillets
45-½"φ Longit. bars spaced as shown
SECTION J-J
SECTION K-K
Protection as directed
Gravel pocket as directed
Sidewalls same thickness at base as adjacent floor slab
PLAN OF CULVERT
4½" Dia. holes for gate stem guard.
⅝"x10" Anchor bolts. Proj. 2¼
½" Elastic filler
PLAN AT TRAJECTORY
Vertical curve
PLAN OF STILLING POOL
Undisturbed natural foundation or thoroughly compacted backfill
Buttresses may be omitted if backforms are not required
Sta. 2+19.50
LONGITUDINAL SECTION OF CULVERT
Paint surface of joint with hot tar or asphalt
LONGITUDINAL SECTION AT TRAJECTORY
LONGITUDINAL SECTION OF STILLING POOL
2" Weep holes @ 5'-0"
End alternate bars at half wall height
NOTES
See sheet 1 for general notes and estimated quantities.
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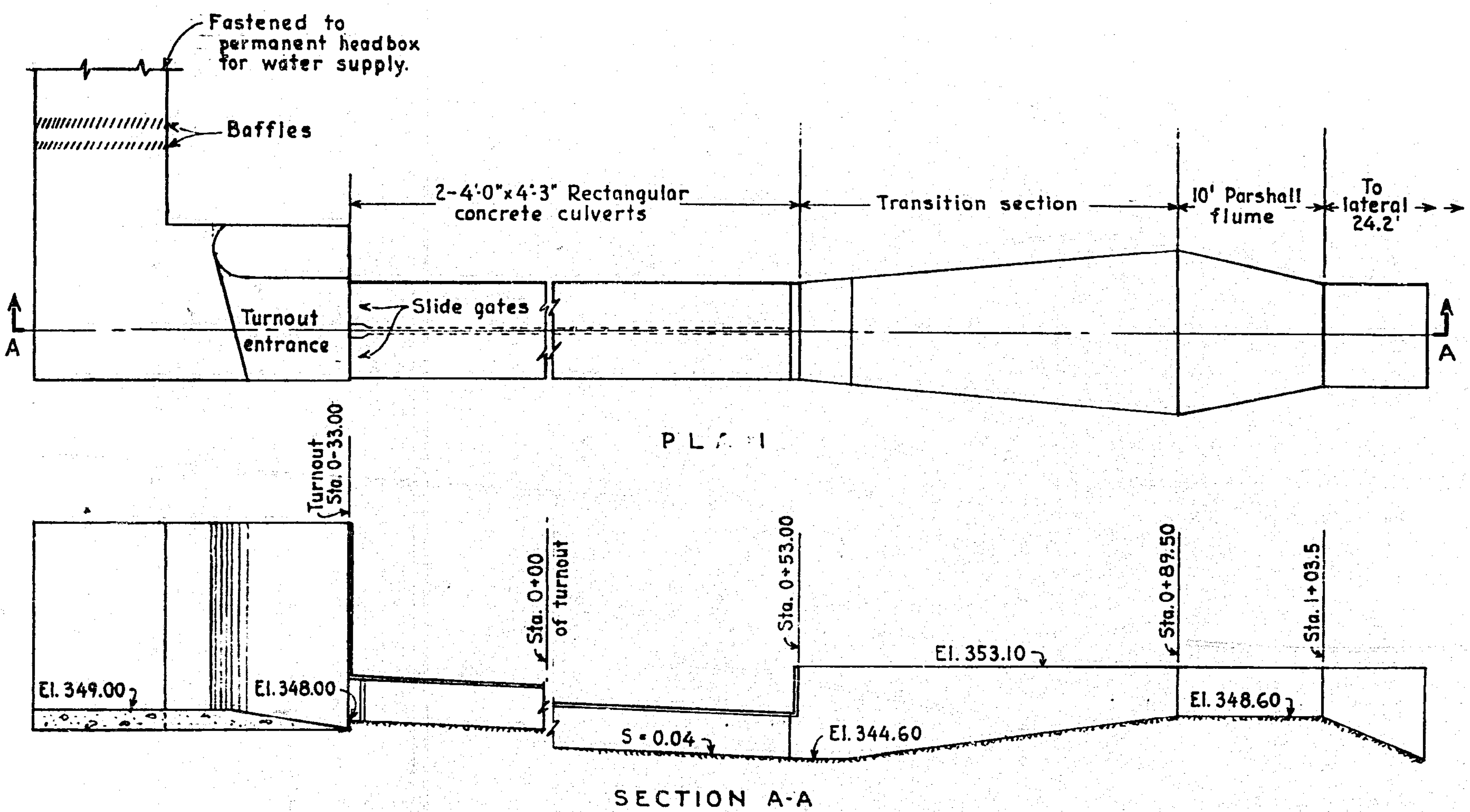
FRIANT DIVISION
MADERA CANAL-STA. 1302+10.26
DRY CREEK SIPHON, CHECK, AND TURNOUT
TURNOUT
DENVER, COLORADO
214-D-10403




MADERA CANAL - DRY CREEK TURNOUT
WATER MEASURING DEVICE
1:10 SCALE MODEL STUDIES
MODEL LAYOUT

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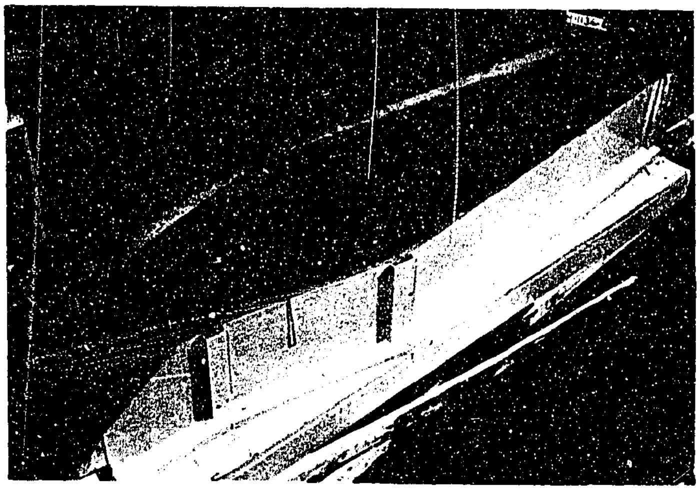
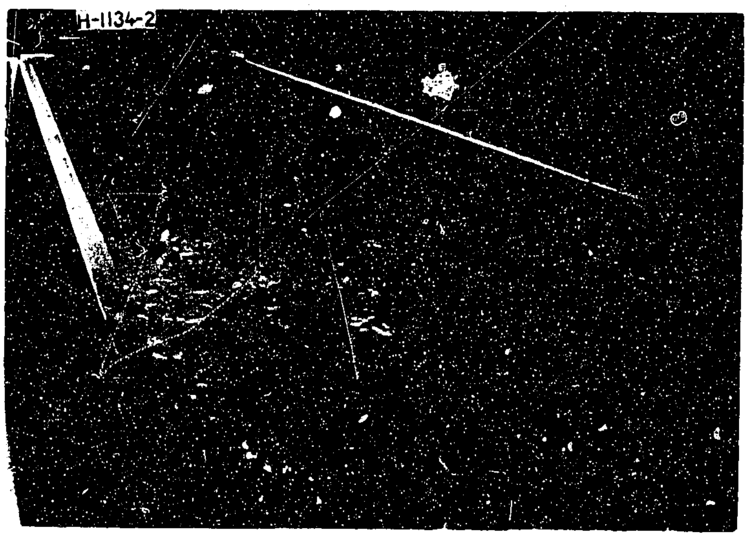
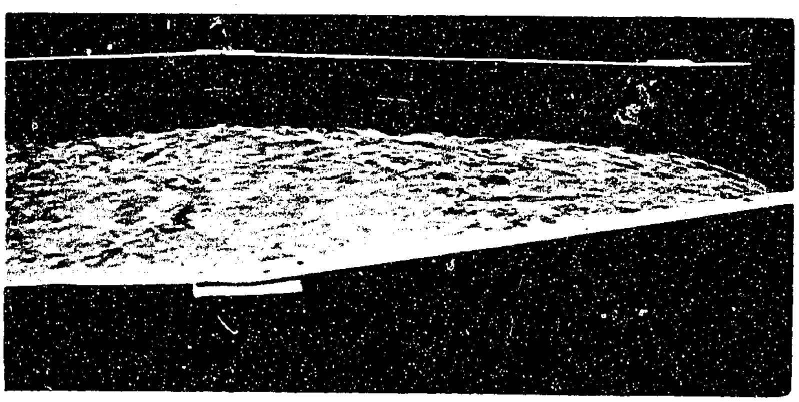
FIGURE 4



General view of flow in transition section and Parshall Flume.



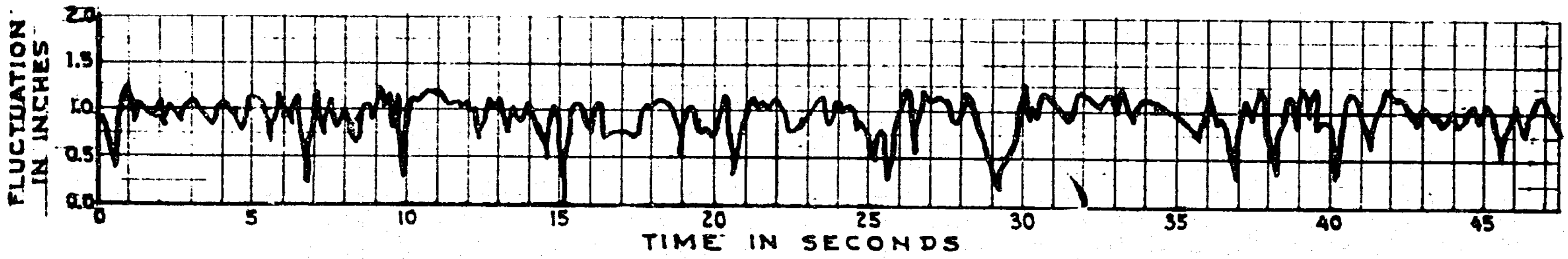

Close-up view of flow in transition section.



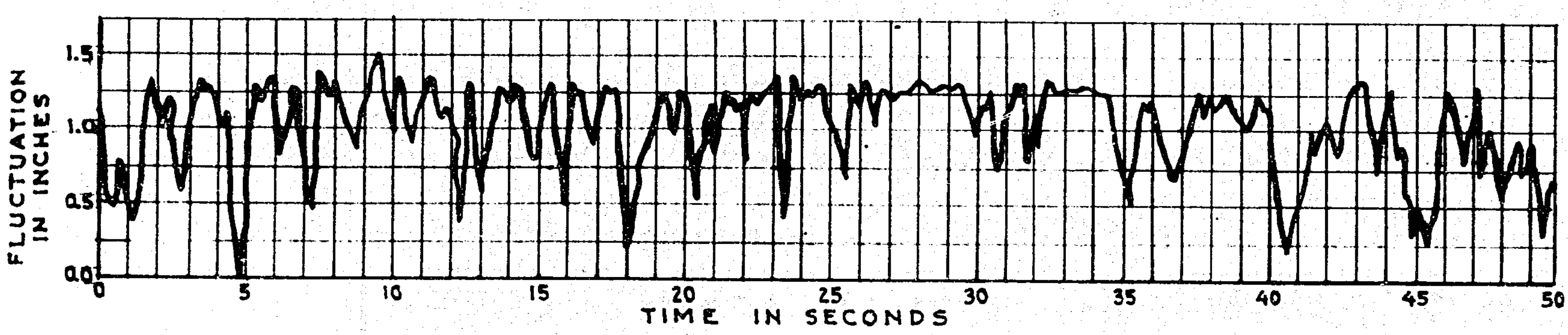
Close-up view of flow in Parshall Flume.

MADERA CANAL - DRY CREEK TURNOUT
WATER MEASURING DEVICE
1:10 Scale Model Studies
Preliminary Design (Recommended)
Flow at 230 cfs.

FIGURE 5




A. PRELIMINARY DESIGN (RECOMMENDED)




B. MODIFIED DESIGN

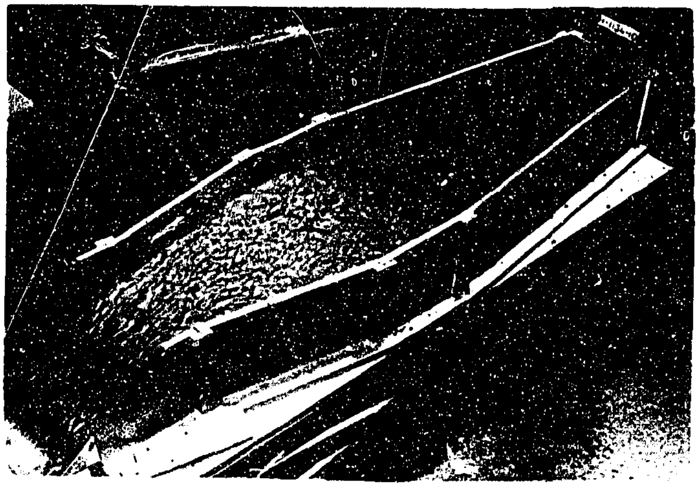
MADERA CANAL - DRY CREEK TURNOUT

WATER MEASURING DEVICE

1:10 SCALE MODEL STUDIES

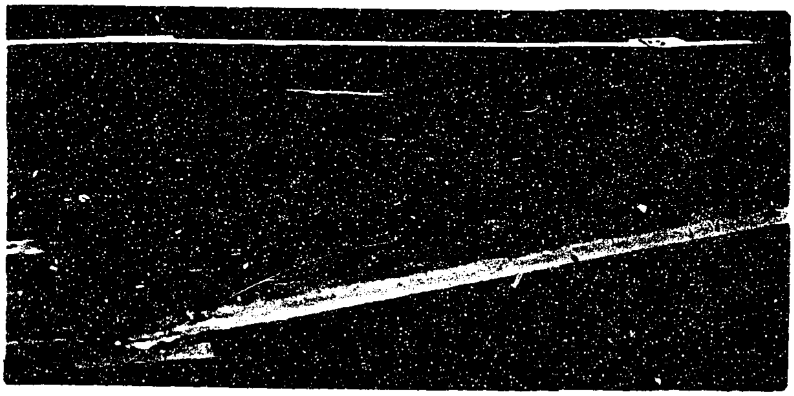
WATER SURFACE FLUCTUATION

FIGURE 6



General view of flow in transition section and Parshall Flume.

Close-up view of flow in transition section.



Close-up view of flow in Parshall Flume.

MADERA CANAL - DRY CREEK TURNOUT
WATER MEASURING DEVICE
1:10 Scale Model Studies
Modified Design
Flow at 230 cfs.